Abstract

This paper reports on the design and testing of two digital learning systems. The first, STUDIO*,* supports individual and collective reflection on the design process. It allows design students who have completed a work placement in industry to capture the skills they have acquired and to share their progress. The tool is intended to be used *post facto*, that is retrospectively, to aid development and inform future design work. The second system, *Trajectories,* supports student journeys through a course of study. It is intended to be used live. As students proceed through their studies, acquire new skills, and deepen their existing knowledge they assess their own level of mastery of a specific competency on a continuous basis by connecting it to specific design outcomes.

Introduction

We deploy the notion of design competencies to enlarge our inquiry beyond any one specific course of study. We understand competencies to be more than technical ability or mastery of domain knowledge. Personal characteristics may include cognitive, social and emotional attributes (Dubois, 1993; Lucia and Lepsinger, 1999) deployed by designers in the production of their work. The idea of competencies thus emphasises abilities beyond traditional studio design skills. Some theorists (Boyatzis, 1982) go further to include the environments and relationships featured in a particular context and the motivations and perceptions an individual may have of themselves and their abilities.

We contrast the respective educational and learning cultures of two design schools, one in London and one in Toronto. In Toronto the system is used by undergraduate industrial design students, in London the system is used by an international postgraduate student cohort studying user experience design at masters level. The London course is 35 week-long and ends with a final major project. The curriculum follows a cohort model with students working collaboratively in small groups on a range of projects throughout the course. As user experience design is a convergent discipline students are drawn from many different disciplinary backgrounds including graphic design, media arts, art history and philosophy. Students may also wish to end up in a wide variety of design oriented careers including user research, interface design, information architecture, or experience design. We have found that a competency based approach works well to scaffold the many different pathways available to students.

We assume a set of positions regarding culture in this context and are in sympathy with Hall's (2016) definition of culture as 'experience lived, experience interpreted, experience defined'. Design students address this by reflecting on their own experiences, and reaching out to inquire about the experiences of others. Designers use a wide range of tools to interpret experience from drawing to coding, and impose constraints to define the experiences they are designing for. Hall also defined culture as a space of negotiation, open to diverse voices and responsive to people, places and languages. We take the view that culture can be thought of as national, institutional, pedagogical, and individual.

Findings suggest there is common ground between tagging activities with competencies to identify how they may inform future work and a competency-driven categorisation of project work. Differences are clearest in how the systems are structured temporally and how they contribute to different aspects of a design student's personal profile. The conclusions we draw from this comparison include the centrality of local pedagogical cultures, and the need for a multi-faceted and integrated curriculum that can stimulate self knowledge.

Background

Work in digital learning covers a wide range of topics. Research into online classroom delivery in the early days of the web (Siegel and Kirkley, 1997) emphasises the linked and dynamic nature of web based information access, the threat to validity and integrity of material published outside established practices of editorial reliability, and the screen based experiences of learning online. This work is followed a decade later by more systemic and applied approaches to digital learning that examine the challenges for learners of a digitised information landscape and look across at adjacent domains of knowledge and practice for methods that might be useful.

Peters (2000) uses the phrase 'digital learning environment' to describe how learning using digital technologies is a fragmented experience using multiple devices, operating systems and softwares. Prensky, (2003) identifies game based learning as fruitful for engaging young learners, Clyde (2004) focuses on what she calls 'digital learning objects' meaning content items, communication tools, assessment items or learning management tools. The two projects we discuss in this paper could certainly be described as knowledge management tools but with the particular emphasis that practice based creative learning activities involve. The introduction of the first iPhone in 2007 meant a turn in digital learning research towards mobile learning with the implication that digital learning systems imposed on students by University IT departments such as *Moodle*, or *Blackboard* would be rendered hopelessly out of date. Jarvis (2010) points out the possibilities for 'experiential field-based learning' whilst also identifying that learners may end up feeling exposed and frustrated if the systems they use are unfamiliar. The transformation of the delivery of education and training by mobile learning is evident in examples from nursing, museums, and distance learning (Ally, 2009). In art and design education specifically Heaton (2019) opens up a space for 'collaboration, moral consciousness, and social responsibility' in digital provision, suggesting a sensitisation an alignment of art and digital practice, what she calls 'curated cognition'.

We can thus see a transition from researchers interested in digital pedagogies from viewing them as a threat to established knowledge practices, to offering opportunity to learn from adjacent domains, to a systemic analysis of a fractured technological landscape. There can now be very few design education curricula with no element of digital provision. This might include students using creative software, online materials such as theoretical readings, online marking and assessment, digital submissions in the form of blog posts and PDF files, or digitally enhanced outputs such as spaces and products.

The projects we describe in this paper are knowledge management tools for design students and are more accurately described as tools for creative reflection. Valkenburg and Dorst (1998) describe some cognitive tools for creative reflection used by design teams. These draw on Schön's theory of reflective practice by attempting to specify how designers frame a problem, what actions ensue and how they are named by designers. Actions are captured in the concept of moving, meaning making choices and generating ideas. Mewburn (2012) positions actor network theory as a way to challenge and enrich Schön's notion that the design teacher is the source of knowledge for design students through demonstration of their own 'artistry'. Instead, she suggests the design studio contains non-human technologies (actors) arranged in a specific relation to each other (a network) such as photocopiers, projectors, computers, desks, cellphones that all contribute to the pedagogical situation. We thus position our own work on digital systems that support creative reflection as acting in a way that similarly constitutes a movable, individualised but peer sustained learning digital environment.

Tools for reflection are commonly taken to be abstract. Gray (2007) epitomises this approach in a study of tools for reflection in management learning. He mentions storytelling, conversation, dialogue, metaphor and analysis as tools for reflection in the learning process for a student of business management. Where technologies are used to support reflection in education they tend towards presenting portfolios of completed tasks for students to reflect upon (Oner & Adadan, 2011; Oakley et al., 2014). Both *Studio* and *Trajectories* feature aspects of this function but are more oriented towards collaborative generatively and the kind of abductive reasoning common in design (Kolko, 2010). The projects discussed in this paper express the generative nature of design work and the ways in which learning design involves students making things that have not existed before. So while our tools may encourage abstract qualities in the process of reflection such as conversation, storytelling and metaphor these are understood to be fundamental to design learning and thus arise in the doing of design work.

Resnick et al's (2005) set of principles for tools that support creative thinking epitomise another strand of research in the field of digital tools for creative work in design. We are in broad sympathy with these principles which include *support exploration*, *support collaboration*, *design for designers* among others. We note however that they are oriented towards software that designers can use to create their designs such as image manipulation tools, or 3D modelling applications. Instead our focus is on facilitating reflective evaluation of the process of creating design work, and reflection and evaluation of the work once it is completed.

STUDIO

OCADU's center for emerging artists and designers (CEAD) has identified 'self-learning' and 'self-reflection' as critical capabilities for students doing internships. To help foster these capabilities in students, CEAD has explored the use of on-line tools and mobile apps that can support student in their self-reflection processes. STUDIO is a smartphone app that responds to this need. The application features four main functions. 1. Students can use STUDIO to write down and document their everyday reflections on what they do and learn during their work placement. 2. The app provides a series of probing questions to stimulate thinking about the learning in their everyday interactions. 3. STUDIO allows students to add photos and text annotations to their entries.
4. STUDIO has sixteen predefined competency tags, each representing one of the competencies associated with experiential learning. The competencies have been defined and curated in collaboration and consultation with teaching staff in faculties of Art and Design and with experiential learning specialists. By tagging each diary entry with up to three competencies students build a visual representation of the competencies they are growing in, those that they face difficulties with, or those that are lacking. This provides opportunities for identifying gaps in learning and validating individual strengths. Students can choose to share their learnings with their peers or not. If an entry is sharable, the student can open their entries for feedback. In this way STUDIO works as a social network of students who are engaged in a workplace learning experience.

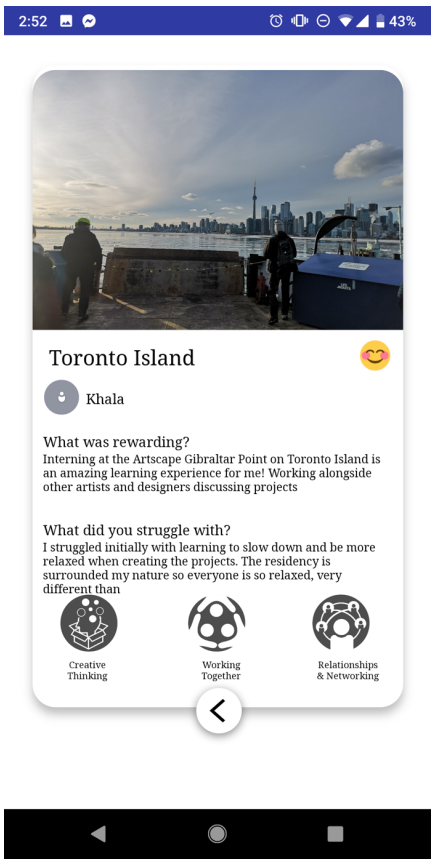

Figure 1.

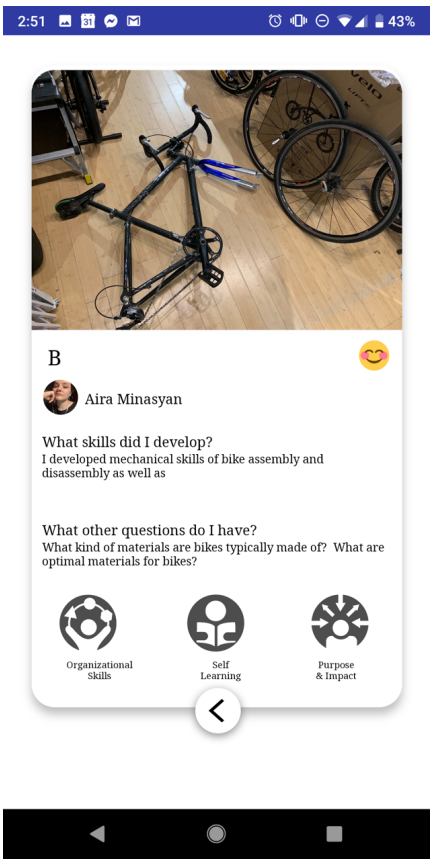

Figure 2

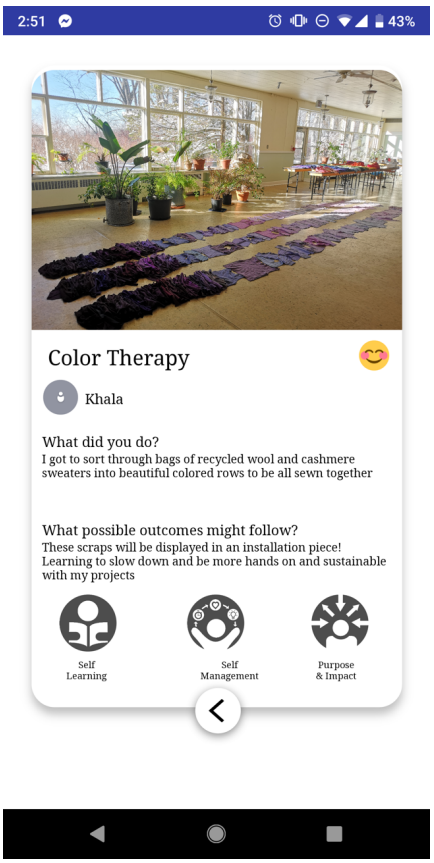

Figure 3

STUDIO has been tested by two student groups of five each. Group 1 - in a structured context within the Design Internship Placement Course, and Group 2 – in an unstructured context among students enrolled in independent Field Placements.

For Group 1 STUDIO was integrated into the placement experience. Key features of this group included requiring students to submit one post, one comment, and one response every week during the semester. Discussions related to posts and comments occurred during every in-class meeting and was integrated into final presentations. During the first week of introductions, students were introduced to the Benchmark Activity, which features a printout of the sixteen competencies and asks students to identify the competencies they want to work on or improve. They were then asked to select 12 out of 16, then 6 out of 12, then 3 out of 6, and 1 out of 3. An in-class discussion around their final choices then took place. In the final session students were asked to complete the benchmark activity again. They were asked to identify the competencies that they worked on or improved throughout their placement. There was then follow-up discussion around the students' personal experiences.

For Group 2, there was an unstructured integration of the app into the placement experience. While students were given a tutorial and encouraged to use the app, there was no established structure for how the student should use the app, nor minimum engagement requirements. Group 2 received no reminders apart from a mid-term and year-end check in.

Feedback from the testing process shows a number of findings. Students felt empowered by the immediacy and visibility of their entries, particularly that they were able to see entries of their own

and their peers. The list of competencies was very useful in establishing terms and framing the internship learning outcomes - ‘a great way to make sense of the experience’. The terminology made it easy to associate moments in the workplace with what was covered in class. The brevity of the entries ‘took away some intimidation related to reflection’ allowing timely and relevant reflections related to the placement because each entry was expected to be so short. One student was excited about the potential to take notes about some of the things she was facing as they happened. Se felt that ‘using a cellphone would be fast and easy compared to having to remember thing and write them down when I get home’. Negative feedback included difficulties creating an account and logging in, and accessibility problems with a screen reader unable to read all menu items. Navigation was an issue ‘the UX means it is not clear how to navigate the posts, I felt the process was complicated and not totally intuitive’, ‘I could use more guidance in the app on how to use it’. More detailed comments include ‘it would be good to be more open ended and have a framework for structuring thoughts’ and ‘the ability to export or share selected posts both private and public would allow this to become part of graded assignments’.

In summary, there is clearly more work to do to develop STUDIO, particularly around integration with course curricula and accessibility, but the ability to frame the informal learning that takes place during a workplace internship in terms of competencies that relate to specific activities helps students keep track of, and share, what they are doing and how it is valued at program level.

Trajectories

MA User Experience Design (UX) at London College of Communication is a 45 week Postgraduate degree. Students come from many different cultural backgrounds including from China, Italy, Brazil, USA, Ireland, Korea, and India. Students also have diverse educational backgrounds in graphic design, product design, philosophy, architecture, finance, computer science and marketing. UX is an integrative and convergent discipline and provides creative opportunity in fields such as design research, user interface design, interactive prototyping, creative coding, interaction design and increasingly, service design and experience design. There are thus many pathways or trajectories through the program that means students, even while collaborating on the same project briefs, may have different goals and end up with very different design abilities. *Trajectories* is a smartphone app that addresses these many possible routes through the program by using the competency model we have explored in previous work (Fass et al., 2017, 2018). Like STUDIO students choose a maximum of four competencies from a grid of sixteen per project. The sixteen competencies are the result of two years research and consultation activity including workshops with staff and students. They are intended to provide a set of choices for students to decide what they consider to be their existing strengths and what they wish to be better at. The focus of *Trajectories* is on completed and ongoing design work. Competencies are thus connected to visible and shareable output. Projects are connected to assessed program units, and specific design briefs. On launching the app students must initially populate their profile with a project including title and image. Then four competencies are attached to that project and a level chosen for each one. Project work is described and made available to the whole cohort at various levels of visibility for peer and tutor feedback.

Trajectories is structured around three navigational principles. Timeline shows how an individual is progressing through the program week by week. This gives an overview of competency levels per project as they develop over the weeks of the unit, and ultimately of the whole course. Competencies shows the four specific competencies selected by the student that are associated with a particular project, with levels set in the most recent week. Projects displays each project

entered by a student. Projects have text descriptions (shown in Fig. 4) and are connected to units (shown in yellow boxes in Fig. 6).

Figure 4. Timeline

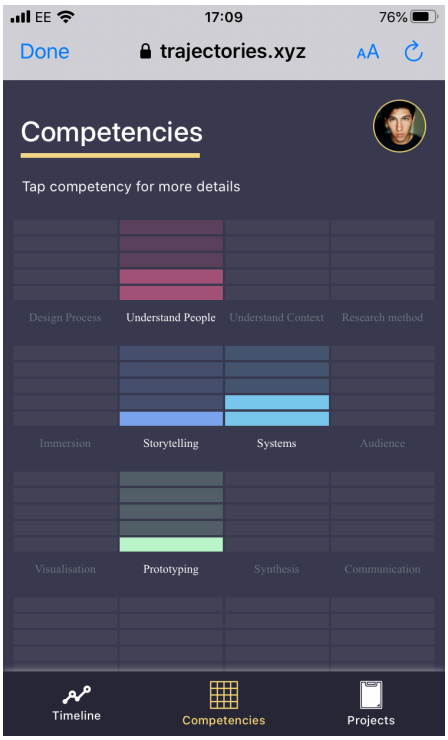

Figure 5. Competencies

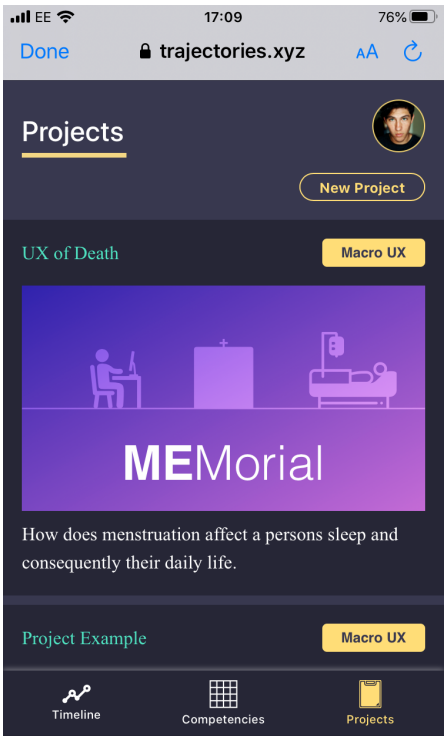

Figure 6. Projects

Further detail about individual competencies is provided in order to describe what they mean, and how they are applied in UX. Most importantly, in *Trajectories* competencies are exemplified and explained through their application on projects that other students have completed or are currently working on. In this way we hope to emphasise through design example rather than theoretical description. Reflection is thus based on student output, allowing competencies a degree of latitude and flexibility in what they come to mean over time for individuals and groups. At the end of the program after 45 weeks students can orient their graduating portfolios and career aspirations towards those competencies that they can provide evidence for in the work they have done.

Trajectories has been tested by 12 students by asking them to use the app in prototype form as they worked on a design project and provide spoken and written responses on their experiece. Positive feedback includes comments about the depth of explanation ‘I like that there’s a definition for each competency since this is the first time I have encountered the idea’, and the learning style enabled by a competency framework ‘Tracking the competencies allows for a much more relaxed learning experience instead of a strict marking scheme.’ Using competencies to frame the learning journey allowed students to reflect on their current learning position - a snapshot of how they are doing on the course and why, ’By breaking down what there is to be learned in this way it helps me to what I’m finding most interesting and why I want to develop those skills further.’ The system helps students to to think about their future development ‘Competencies allow me to break down the skills I believe are important to have, the skills I have already started to develop and what other skills I can develop.’ and position themselves in the broad field on UX design.

The emphasis on projects as a way of demonstrating competencies through completed design work, rather than written reflection alone was seen as valuable because it recognises the practice

based nature of the course and ‘lets us showcase exactly what skills we are using and how those skills develop through different kinds of designed outcomes and topics this in turn allows us to see where our strengths lie by adapting to these different topics of research and design.’ Having a personal portfolio of projects helped students understand and identify their strengths, how those strengths have been expanded and how they might be reflected in career opportunities ‘It (projects) helps in understanding which skills I value most, use most often and have improved the most in over time through the course of individual projects and the entire course. The competencies themselves help me to see exact names of skills that could be found in job roles.’

Elements of the system to improve include a peer review function ‘I feel some of the things missing are anonymised peer reviews allowing people to give one another advice on how to improve their competencies and help to keep evaluations of competencies honest’. A connection to careers in the field was also seen as useful ‘having a job roles page so that you can better match the competencies you are happiest improving with against what careers those combined competencies are best suited to.’

We can see from these reactions that the value is the system is in how it helps reflection on student development over time and hands control of the learning journey to students in a more granular way than summative assessments can provide. In addition, it can be difficult to stand back from everyday studio tasks and projects to gain an overview of how an individual might be progressing, *Trajectories* was seen to help this process. Finally, the connection with post-university career opportunities was identified as a current weakness that can be improved along with some difficulties in navigation and data entry tasks. These will be a focus for the next phase of development.

Discussion

While it is early days for both these systems, there is much to build on. The implications for digitally enhanced pedagogy are related to levels of autonomy for individuals and groups, and to the possibilities for peer learning and review. By enabling self assessment the power of experts in design teaching situations (suggested by Schön in the form of 'teacher artistry’) that was questioned by Mewburn (2012) is mitigated. Students are empowered to assess their own levels of ability in a particular competency and to elicit feedback from their peers and tutors on a level playing field. The flattening effect of digital systems (Fass, 2018) is here an advantage since teaching staff do not have privileged access to an individual’s feedback section. This chimes with Kulkarni et al (2013) who find in a study of large online class using peer and self-assessment that there was high correlation with staff-assigned grading. In terms of pedagogy in design education it is clear that most forms of design today now include aspects of digital creativity. Students arrive for study at design school equipped with a sophisticated understanding of digital ecosystems, although perhaps not the critical ability to use them productively. STUDIO and Trajectories both validate a specifically digital approach to reflection and review. Some of the negative feedback from students shows how far it is possible go and how high expectations are for a student facing digital learning tool.

The implications for personal development and the individual learning journey are shown in the ways both systems have the potential to transcend their immediate context. In the unstable and unpredictable economy inhabited by creative professionals, who are more likely than other workers to be self employed freelancers (Pitts, 2018; Merkel, 2019), sustaining a creative career over a lifetime of work can be a major challenge. The ability to identify strengths, and provide evidence for

those strengths enables designers to continue to build their abilities after graduation and adjust to the ever changing priorities of the creative marketplace. Critical reflection on competencies and on design work shows the kind of advanced abilities valued across the design sector and shown by Giroux (2018) to be fundamental qualities for ‘socially responsible and civically engaged citizens’. The implications for design education are clear. Without access to tools; whether cognitive, abstract, tangible or digital for critical reflection students are at the mercy of the ‘disimagination machine that remakes social identity by turning civic subjects into consuming and marketable subjects.’, (Giroux, 2018).

Finally, the implications for a competency based view of design education are validated by both systems. By emphasising competencies rather than skills, abilities, or expertise students are encouraged to see themselves as acquiring a mix of complementary capabilities that may fluctuate in level depending on what they are doing, and who they are working with. The competency framework allows for self identification by students with a set of competencies that can gain resolution and detail through design work over the duration of a program or a workplace internship, and ultimately over a creative lifetime. A competency based view of design education also admits new areas of design such as bio-design or robot behaviours. In this way design curricula can be constantly updated within specific programs and respond in an agile manner to the emergent challenges of the age. Our future work in this area involves a global reporting project in the context of a Cumulus Working Group. We have elicited participation from over 30 design education institutions and 100 individuals who have agreed to contribute to an ongoing project that gathers the design competencies of the future, and provides evidence for how they are addressed in curricula worldwide and in student design work.

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